

LIGHTNING ON THE KITE WIRE.

In the MONTHLY WEATHER REVIEW for April it was suggested that a simple method for overcoming the difficulties incident to the destruction of the kite wire by discharges of atmospheric electricity must be found before we can trust the kites in the upper regions in the neighborhood of an area of thunderstorms. Probably the first method that occurred to Professor Marvin was to substitute silk for wire. But this is evidently expensive; and as the silk cord would necessarily be of much larger diameter than the wire, there would be a proportionate injurious wind effect, diminishing the altitude of the kite. His next suggestion was the retaining of the steel wire as a whole, but inserting an occasional stretch of 50 to 100 feet of silk cord. Now, we must recognize the fact that the electric current along the wire increases rapidly from a strength sufficient to give sparks an inch long up to the destructive lightning flash. A moderate discharge or flash destroys the continuous steel wire, but a stronger flash will jump over 50 or 100 feet of silk cord and still destroy the wire, so that the introduction of the silken loop will simply delay the destructive flash for a few minutes, and does not solve the problem of perfect safety. It was, therefore, put aside by Professor Marvin almost as soon as he suggested it to the Editor.

The same idea was subsequently suggested both by Professor Rowland, of Johns Hopkins, and our amiable colleague, Dr. J. W. Kales, of Franklinville, N. Y. The latter adds that the silk cord should be covered with insulating varnish, to protect it from moisture and rain, and he adds that—

The trouble arises from grounding the wire, thereby making it a conductor of all the electricity in the higher air. Of course the wire must be grounded at the reel. Lightning destroyed our telephone wire when it was accidentally grounded against a dwelling house. The wire was $\frac{1}{16}$ inch in diameter and 1 mile long. The house was damaged, but not set on fire.

Professor Rowland verbally stated that at first thought he saw no way to make the kite line perfectly safe, except to make it either too poor a conductor to transmit any electricity or so good a conductor that it will transmit the entire lightning flash without becoming overheated.

As any increase in the diameter of the kite line injures its efficiency as a means of carrying our meteorological apparatus to great heights, we judge that better suggestions are still in order, and that for the present it will be best not to fly the kite when thunderstorms are approaching. On the other hand, in cases of special interest, it is allowable to fly the kite even if the line is burnt up, because we have hitherto always secured the kite and its record after a little search.

CURRENTS INDUCED BY DISTANT LIGHTNING.

In the Comptes-Rendus of the Paris Academy of Sciences of June 13, 1898, page 1743, M. Ducretet says:

I have had occasion to register the atmospheric electric discharges into the receiver at a station for "hertzian telegraphy without wires" installed at my house. The mast rises above ground to a height of 26 meters; the ground is about 55 meters above sea level. This mast dominates the neighboring houses and can be seen from a great distance. The insulated conducting wire placed at the extremity of this mast is 32 meters long; this collector of electric waves penetrates into my laboratory and is connected with one of the electrodes of the Branly radio-conductor of the receiving station; the other electrode is put to the ground.

Saturday, June 11, from 2:30 to 3:40 p. m., during a thunderstorm my automatic receiver registered 311 intermittent atmospheric discharges successively as they made their presence felt upon the collector of the mast. These discharges were registered before flashes of lightning were seen or thunder heard.

We have here a phenomenon quite identical with the lightning on the kite line, as described in the MONTHLY WEATHER REVIEW for April. An insulated kite line is the conducting thread and collector of electric waves for the system of Hert-

zian telegraphy without telegraph lines, and in fact has already been applied for that purpose, as will be seen from the following article.

NEW USE FOR KITES—THE TELEPHONE KITE.

According to the journal Electricity some recent experiments have been made in England, in which a kite was made to support a telephone wire. Apparently the middle of the wire was fastened near the kite which was flown from a ship, as if at sea. One end of the telephone wire remained on the ship, the other was dragged by the kite a long distance to leeward until it was without difficulty dropped on the deck of H. M. S. *Dauntless*, where it was secured and attached to a telephone apparatus. In this way, vessels that are perhaps 2 miles apart can be brought into telephonic communication, and when no longer needed, the kite and telephone wire are reeled back to the first vessel without any loss. In the present case the experiment lasted four hours, during which time the kite remained suspended, held in place by the two wires and communication between the two vessels was uninterrupted.

It would seem that such a method of communicating between the shore and a vessel to windward wrecked in the breakers would sometimes be as useful as the Francis life-saving apparatus. The kite telephone, so-called, would prove especially valuable at nighttime. The same method would seem to be as practicable for carrying a telephone wire over a difficult country or forest as over the ocean, and probably as useful in war times as in time of peace.

SAFETY FUSE FOR LIGHTNING ON THE ANEMOMETER.

Mr. P. E. Doudna, voluntary observer at Colorado College, Colorado Springs, makes the following report:

At 4:30 p. m., July 15, during a severe electrical storm, the anemometer in use here was injured by lightning. Thinking that a description of the broken instrument and an explanation of the nature of the discharge may be of interest, I submit the following:

A hole was torn through the glass cover and the shattered glass thrown outside of the instrument. On the opposite side the cap which closes the oil hole was thrown out, but not injured in the least. The cups and arms attached to the spindle would not turn. On removing the cap that covers the mechanism of the instrument I found that the copper wire on the inside of this cap was fused. After working the cups a few minutes they seemed to turn as smoothly as ever. I put in a new connection to supply the place of the fused wire and used an oilcloth cover instead of the glass. The instrument was then put back in its place (a position 12 feet above the roof). The self-recorder commenced immediately to give its usual record. At first I was at a loss how to account for the peculiar nature of the injury done the instrument, but it seems to me now that the lightning must have struck the wire connecting the anemometer with the register, and fusing the wire inside the cap, which fits quite snugly and has only one small opening, created a force through the sudden expansion of the air inside the cap sufficient to shiver the glass cover of the cap, to throw the oil cap out, and to force the spindle carrying the cups so tightly into its bearings as to prevent rotation.

The record which the instrument made just before the accident shows that the wind was blowing 12 miles per hour. The wire was fused just as the connection was made on a tenth mile, and instead of the customary long offset there is only a very thin line extending slightly farther out from the base line than the others.

In this connection Professor Marvin notes that the small wire that was fused is finer than the wire in the coils of the electro-magnet; it therefore melted before a sufficient current passed through to injure the coil of the magnet, and has, therefore, served as a safety fuse for the anemometer. The fact that the spindle stuck in its bearings seems to indicate that it needed oil rather than that it was the direct effect of lightning.

WHICH TREES ATTRACT LIGHTNING?

In a letter to the Chief of the Weather Bureau, Mr. Alexander McAdie, local forecast official at San Francisco, lately urged

that the Weather Bureau investigate the question why some kinds of trees are more frequently struck by lightning than others. He suggests that actual experiments with artificial lightning, such as that given by the apparatus constructed by Prof. John Trowbridge, at Harvard University, may be able to show the intrinsic differences in the effect of the discharge through different kinds of wood, and that the physicist, the Weather Bureau, the Division of Forestry, and the Division of Vegetable Pathology might combine in this study. On the other hand, Professor Trowbridge writes us that "the character of the wood, whether oak or pine, weighs but little in comparison with other physical conditions." The following paragraph quoted from Mr. McAdie's letter of February 19, 1898, will suggest lines of study to many voluntary observers:

I have the honor to invite attention to the need of an authoritative answer to the question "Why some trees are more frequently struck by lightning than others?" At first glance the subject may seem to be foreign to the work of the Weather Bureau; but investigation will show that some phases of the question are germane to the work of this Bureau and proper subjects for study.

Primarily it is a matter of saving human life; and in that direction the Weather Bureau has always put forward its best efforts. Many people, particularly farmers and those who work in the fields exposed to thunderstorms, will work until the storm is almost upon them, and then run to the nearest tree for shelter. If the tree is an oak and the charged thunder clouds are moving toward it, with high electrical potential, the person or persons under the tree are in the line of strain, and all unconsciously are contributing to the establishment of a path for the lightning discharge through themselves. Records show how frequently death results, and how dangerous it is to stand under certain trees during thunderstorms. On the other hand, if it had happened to be a beech tree, there is some reason to believe that it will afford safety as well as shelter, though the reason why is not at present known. It is known that the oak is relatively most frequently and the beech least frequently struck. If the relative frequency of the beech is represented by 1, that for the pine is 15, trees collectively about 40, and oaks, 54. Trees struck are not necessarily the highest and most prominent. Oak trees have been struck twice in the same place on successive days. Trees have been struck before rain began and split; and trees have been struck during rain and only scorched. It is plain then that before any statement is made as to the danger of standing under certain kinds of trees during thunderstorms, the more general questions of the effects of lightning upon trees should be gone into. Such a study would be best undertaken by coöperated effort of statistician, physicist, and vegetable pathologist.

The Editor hopes that those familiar with the forests in their respective neighborhoods will contribute a few words as to their own local experience in the matter of the relative frequency of lightning strokes on different kinds of trees. Of course, their statements must be accompanied by a careful estimate of the relative number or frequency of the trees themselves. Thus, if in a forest where oaks and pines are fairly well distributed, the pines are twice as numerous as the oaks, and it has been found by actual count that during any given number of years, 10 oaks and 5 pines have been struck, it will, of course, follow that the relative frequency of the lightning strokes is as 4 to the oak and 1 to the pine.

In this connection the following remarks by Mr. Austin Cary, of East Machias, Me., have just been received. Mr. Cary has had wide experience in the forests of New England, and says:

The only trees I ever noted struck by lightning were large spruce and pine and, sometimes, stubs left after a fire in burnt land. My idea was that the tall, prominent trees attracted the strokes. Pines usually stand high above the surrounding timber. I certainly think such trees are particularly liable to be struck. I have also frequently seen large spruce hit by lightning. Sometimes a narrow cut is made down the bark; sometimes big, long splinters are split out and thrown around. I do not remember ever to have seen a hard-wood tree marked by lightning. The flat crown of these trees and the comparatively even cover which a hard-wood forest presents may explain this. I learn, however, that elms are likely to be struck. This may be because they, as shade trees, stand apart.

TIN ROOFS AS LIGHTNING CONDUCTORS.

Under date of May 28, 1887, the journal of the Weather Bureau station at Little Rock, Ark., which was at that time kept by Mr. W. U. Simons, says:

A thundershower; thunder very heavy, and brilliant, zigzag and ball lightning, at times very near; night cloudy. Rossner Block struck by lightning.

In a recent letter, dated July 13, at Key West, Mr. Simons gives a fuller account of this event, as follows, having especially in view the efficacy of a tin roof as a means of protection against damage by lightning:

Mr. Fred. Rossner had recently erected a large three or four story brick building, with a tin roof, distant from the Weather Bureau office about 300 feet. During a heavy rain and thunderstorm a flash of lightning struck the roof of the Rossner building. I was standing at the office window, and, although for an instant the flash blinded me, I saw it apparently cover the entire roof with a thin blue flame, resembling alcohol burning on a flat surface. Almost immediately it appeared to flow toward the southeast corner of the building and disappeared. I learned afterward that it had passed down the waterspout at that corner of the house, and where it went to earth there was a hole in the ground about the size of an ordinary water bucket, but not a joint of either the tin roof or the waterspout had been melted. My idea of it at the time was that the rain on the roof formed such a complete covering that the electricity diffused itself through that, then followed the waterspout to the ground, using the water as a conductor.

From the preceding description it would seem that in this case the building was saved from injury, not so much by the tin roof and tin water spout as by the layer of rain water that fortunately covered the roof and filled the spout at that time. Had the roof and spout been dry, it might well have happened that every soldered joint had been melted and many a square of tin burned to destruction; under such circumstances, the building itself would have been in great danger.

RAIN GUSHES AND THUNDERSTORMS.

The article in the MONTHLY WEATHER REVIEW for July, 1897, page 303, has called forth several letters during the last year from those interested in the subject from which we quote as follows:

Prof. Milton Updegraff, Director of the Astronomical Observatory of the State University at Columbia, Mo., says:

I remember seeing somewhere the following plausible explanation of the connection between rain gushes and lightning. The large drops of rain, being formed from smaller drops of water, must be charged on their surfaces to a higher electrical potential than the smaller drops of which they are formed, for obvious geometrical reasons. Thus, a sudden and simultaneous condensation in a cloud would produce a higher electrical potential which might cause a flash of lightning which would be seen shortly before the rain drops reach the earth.

Mr. H. D. Govey, of North Lewisburg, Ohio, remarks:

It is a general expression "that a harder rain, in general, immediately succeeds a flash of lightning or heavy thunder." I have noticed this many times in the last sixty years. If the hard thunder was about overhead then comes the harder rain, but if far distant the harder downpour for a minute or two may not come. There may be electrical attraction or repulsion between the particles of moisture that on a stroke of lightning lets them unite and fall in large drops of rain, but if no lightning so that their electricity may pass off they repel each other and not much rain falls from that cloud. In hot weather, almost invariably, if a heavy cloud arises in the west or in a westerly direction and is not accompanied by thunder then generally very little rain falls from it, but if accompanied by heavy thunder there is a heavy rainfall as long as the thunder lasts, when that ceases the rain also stops. Rain invariably follows thunder [or the thunder (and lightning) follows the rain]. Therefore, to have a "rain gush" the thunder must be overhead (in the zenith) or a little west of it. When a nimbus cloud arises in the west (in hot weather) not much rain may be expected to fall from it unless accompanied by thunder and lightning. Can not electrical attraction and electrical repulsion account for a part, at least, of the phenomena?

Prof. H. A. Hazen, of the United States Weather Bureau at Washington, says:

On Saturday, June 25, 1898, while standing in a sheltered place in this city I had an excellent opportunity for noting thunderstorm phe-